

## Common Sponges from Shallow Marine Habitats from Bocas del Toro Region, Panama

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**ABSTRACT.**—A survey of Porifera biodiversity and distribution was done in three islands of the Bocas del Toro region, Panama. Fourteen sites were explored using mask and snorkel, and occasionally scuba equipment, during ten days. Forty-one species are added to the species known for the region. Our current estimate of sponge diversity in shallow exposed marine habitats of Bocas del Toro is 120 species. Twenty-three species are added to the Panamanian sponge fauna, four of which are new species currently being described. A patchy distribution was observed for most of the sponge species, while few species were present at all sites visited. Approximately 23% (30 species) of the diversity encountered was widely distributed. The species composition of the most typical or common sponges from reef, seagrass beds, or mangrove habitats, agrees with that of other Caribbean sites. An appendix with a field guide to the species encountered in this study is presented.

**KEYWORDS.**—Sponges, biodiversity, mangrove, reefs, field guide.

### INTRODUCTION

Sponges are among the most diverse and abundant inhabitants of benthic tropical communities such as coral reefs and mangrove systems (Rützler and Feller 1987; Diaz and Rützler 2001). Coral reef sponges in the Caribbean usually constitute the most diverse benthic group, 100-200 species, while other conspicuous coral reef groups such as hexacorallians or octocorallians are represented by 50-70 species (see Diaz and Rützler 2001 for a review). In subtidal mangrove habitats, sponges, along with algae, ascidians, anemones, and hydroids, are among the most conspicuous epibionts (Litter et al. 1985; Rützler and Feller 1987, 1996; Calder 1991a; Ellison and Farnsworth 1992; Rützler et al. 2000; Goodbody 2000; Macintyre et al. 2000). Sponge species richness from mangrove systems in the Caribbean ranges from a dozen to 150 species, depending apparently on a combination of physical factors, such as water turbidity, salinity, wave exposure, substrate availability, and tidal ranges, and biological factors such as competition, larval supply, and predation (Calder 1991b;

Litter et al. 1985; Taylor 1986; Ellison and Farnsworth 1992; Rützler 1995; Rützler et al. 2000; Wulff 2000). Despite the ubiquity of this group in Caribbean ecosystems, its diversity and relative abundance remains poorly understood for large parts of the region. Whenever unexplored geographic areas are studied or particular sponge taxa (genus, family, or order) are revised, a considerable number of new species is discovered. Examples of this trend are among recent work carried out in Jamaica (Lehnert and Van Soest 1998, 1999), and Belize (certain taxa such as Chalinidae [de Weerdt et al. 1991; de Weerdt 2000]; or the Axinellidae [Alvarez et al. 1998; or Mycalidae Hajdu and Rützler 1998]), and on the systematic revisions of the family Chalinidae, Haplosclerida, by De Weerdt (2000), or the family Axinellidae by Alvarez et al. (1998).

The archipelago of Bocas del Toro is located on the western Caribbean shore of Panama and comprises more than 68 islands and mangrove keys. Knowledge of its shallow water sponge fauna is limited to two major studies: Guzmán and Guevara (1998, 1999), and Guzmán (2003), who list 63

sponge species from open reef habitats, and Nichols and Barnes (unpublished) who registered 86 taxa from reefs, mangroves, and seagrass beds in the Bocas region, including 12 taxa identified only to family and 11 identified only to genus. The results add up to approximately 79 species of sponge species reported from the area. During August 2003 the first Smithsonian Marine Science Network workshop took place at the Bocas del Toro Station-Smithsonian Tropical Research Institute (STRI). The goal of this workshop was to increase our understanding of the diversity and distribution of poorly-known marine taxa. The present study summarizes the results of a survey of the diversity and distribution of sponges from various shallow water habitats around this region's islands and presents a field guide to facilitate the identification of the most common sponges (see Photographic Identification Guide on this volume).

#### MATERIALS AND METHODS

Twelve sites in the Bocas del Toro Archipelago were surveyed by mask and snorkel during August 3-12 2003 (0-20 ft deep), and

two sites were surveyed by scuba-diving in August 2004 (15-60 ft depth). Table 1 lists the coordinates as well as the type of marine community explored during each visit. Surveys consisted of swimming for approximately one hour and registering the occurrence of each sponge species. When a sponge was encountered it was photographed and a small fragment was collected, labeled, and transported to the laboratory in a cooler. Once in the laboratory, the specimens were fixed in 10% formalin (seawater) and within a week transferred into ethanol 70%. If a species was not recognized immediately, a taxonomic study was performed in the laboratory, using a compound microscope to examine skeleton structure in dried hand sections cleared in Permount medium. Spicule types were determined after dissolving a fragment (2-4 mm<sup>3</sup>) in concentrated household bleach (5% sodium hypochlorite). The samples taken are kept in the Bocas del Toro, STRI, marine station.

A qualitative estimate of the abundance of each sponge species was carried out while surveying each site. Species were classified in four categories: very common

TABLE 1. Sites surveyed in the Bocas del Toro Archipelago region in August 2003, and August 2004 (\*).

Locality	Latitude-N	Longitude-W	Habitat type
Crawl Key 1	9°15'	82°9'030"	<i>Rhizophora mangle</i> fringe (3 ft deep), contiguous to shallow reef
Eagle Park-SW Solarte Island	9°19'	82°13'	<i>R. mangle</i> fringe (6 ft deep) and seagrass
Solarte 1	9°17'030"	82°10'020"	<i>R. mangle</i> fringe (6 ft deep) on internal lagoon
Solarte 2	9°17'987"	82°12'404"	<i>R. mangle</i> fringe (6 ft deep) on canal between islands
Solarte 3	9°17'208"	82°11'650"	<i>R. mangle</i> fringe (3 ft deep), contiguous to shallow reef
Crawl Key Canal	9°15'050"	82°07'631"	Shallow reef (20-30 ft deep) <i>Millepora</i> and <i>Porites</i> dominant corals
Colón Island			
Punta Caracol	9°22'627"	82°18'117"	<i>R. mangle</i> fringe (3 ft deep), contiguous to shallow reef
STRI Point	9°21'169'	82°15'528"	<i>R. mangle</i> fringe (3-6 ft deep), contiguous to shallow reef
ITEC, Colón Is.			Shallow reef. (5-15 ft deep)
Big Bight.	9°22'184'	82°16'586"	<i>R. mangle</i> fringe (6-9 ft deep) along a lagoon
Swan Key	9°27'198"	82°18'024"	Shallow reef. (5-15 ft deep) Strong surge and currents
Pastores Island	9°14'332"	82°19'.968"	Shallow, extensive, <i>Porites</i> reef
Adriana's Key*	9°14'021"	82°10'023"	Coral reef associated with nearby keys, (10-60 ft deep) High coverage of stony coral, algae and sponges
Cristobal Island south*	9°15'379"	82°14'136"	Fringing reef dominated by <i>Agaricia</i> , <i>Porites</i> and large clumps of red alga <i>Amphiroa rigida</i> var. <i>antillana</i> , specially below 20-30 ft deep. Large amount of fine sediments along the reef profile (10-55 ft deep).

(more than ten specimens seen), abundant (6-10), few (2-5 specimens), and rare (one specimen).

## RESULTS

### *Sponge biodiversity*

One hundred and four species were encountered in this study, of which 41 are new for the area (Table 2). As a result, sponge diversity known from the Bocas del Toro region reached 120 species. Four of 12 species identified only to genus are considered new species and are currently being described. These species include two from the order Haplosclerida (*Haliclona* sp. and ?*Xestospongia* sp.), and two from the order Poecilosclerida (*Mycale* (*Paresperella*) sp., and *Iotrochota* sp.).

*Haliclona* sp., and ?*Xestospongia* sp. (see illustration in the Photographic Identification Guide; this volume) are abundant on hard substrata of shallow reef habitats, and both possess endosymbiotic filamentous cyanobacteria. *Iotrochota* sp. is found in muddy areas of certain deeper reefs (>40 ft). *Mycale* (*Paresperella*) sp. is a common species but only found on mangrove roots. It represents the first find of a whole specimen of this sub-genus in the Caribbean. Hadju and Rützler (1998) describe the distinctive spicules of this subgenus (serrated sigmas) found contaminating a specimen of *Mycale* (*Aegropila*) *citrina*, therefore assuming the occurrence of a species of this subgenus in Belizean mangroves but lacking a complete specimen.

Twenty-four species are new record for the Panamanian sponge fauna. Half of these species (13) are exclusively found inhabiting mangrove roots or peat (*Haliclona piscadaerensis*, *H. curacaoensis*, *H. mucifibrosa*, *H. vermeuleni*, *H. tubifera*, *Chalinula zae*, *C. molitba*, *Terpios manglaris*, *Tethya* aff. *seychellensis*, *Mycale magnirhaphidiphera*, *M. carmigropila*, *Mycale* undescribed species, and *Geodia papyracea*). Eleven inhabit predominantly reef environments (*Amphimedon viridis*, *Callyspongia fallax*, *C. pallida*, *Haliclona vansoesti*, *Oceanapia oleracea*, *Spirastrella hartmani*, *Clathria echinata*, plus three undescribed species of *Haliclona Xestospongia* sp., and *Iotrochota* sp.), and the

calcareous sponge *Clathrina primordialis* that can be found either in reef or mangroves. Fifteen species are first records for Bocas del Toro region but were reported previously for other localities in the Panamanian Caribbean. Such is the case of *Cheilonaplysilla erecta*, *Verongula reiswigi* (Guzmán 2003), *Dysidea etheria*, *Haliclona manglaris*, *Cribochalina vasculum*, *Oceanapia peltata*, *Nipahtes caycedoci*, *Spirastrella mollis*, *Lissodendoryx colombiensis*, *Erylus formosus*, and *Halichondria magniconulosa* (Clifton et al. 1997; Wulff 2000).

### *Sponge species distribution and relative abundance*

Most species (58%) occur in one to four sites, while only one species (*Niphtes erecta*) occurs at all fourteen sites surveyed (Table 2). Thirty of the 126 species (23%) occur at five or more sites. *Aplysina cauliformis*, *A. fulva*, *Aiolochoxia crassa*, *Verongula rigida*, *Ircinia felix*, *I. campana*, *Niphtes erecta*, *Amphimedon compressa*, *A. erina*, *Xestospongia caycedoci*, *X. muta*, *X. proxima*, *X. carbonaria*, *Xestospongia* sp., *Iotrochota birotulata*, *Mycale laevis*, *M. laxissima*, and *Cliona delitrix* were common in reefs sites, while *Hyrtios proteus*, *Spongia pertusa*, *Haliclona implexiformis*, *H. manglaris*, *H. curacaoensis*, *H. tubifera*, *Chalinula molitba*, *Lissodendoryx isodyctialis*, *Clathria schoenus*, and *Tedania ignis* were common in mangroves. Three species—*Niphtes erecta*, *Scopalina ruetzleri*, and *Chondrilla nucula*—may be common in both reef and mangrove habitats. The majority of the species (74 of 126) were at least in two of the three habitats surveyed, while 28 species occur exclusively in mangroves and 25 species in reefs (Table 2).

## DISCUSSION

After surveying the shallow water habitats of three islands in Bocas del Toro region in a relatively short time, the known sponge diversity increased 34%. This demonstrates the importance of this kind of exploration to further our biodiversity knowl-



TABLE 2. Continued.

Species	Rf	Sample #	Mangrove				Reef				Mangrove and reef								
			EP	SI	S2	C	AK	CK	SK	Ti	C	CK	1	PI	SP	PC	BB	S3	
<i>Chlamophysilla erecta</i> (Row, 1911)	2,3	BT-157		3										3				2	3
<b>O. Haplosclerida, Chalinidae</b>																			
<i>H. (Reniera) curacaensis</i> (Van Soest, 1980)*	3	BT-017	1		2													2	2
<i>Haliclona</i> (R.) <i>implexiformis</i> (Hechtel, 1965)*	3	BT-015	2	3							2				1			3	3
<i>H. (R.) manglaris</i> Alcolado 1984*	3	BT-014	1		1						1							1	1
<i>H. (R.) muciflora</i> de Weerd et al., 1991*	1	BT-088																	
<i>H. (R.) tubifera</i> (G. & W., 1919)*	1-3	BT-12	2	2							3				2			3	3
<i>H. (Soestella) curulea</i> (Hechtel, 1965)	1,3	NS													3				
<i>H. (S.) picadaerensis</i> van Soest 1980*	3	BT-121		3	3													2	2
<i>H. (S.) twincayensis</i> de Weerd et al., 1991*	1,3	BT-062		3														3	3
<i>H. (S.) vermiculeni</i> de Weerd, 2000*	1,3	NS																	1
<i>Haliclona</i> sp.1 (new species)**	3	BT-045									1								
<i>Chalinula. molibia</i> (de Laub., 1949)*	1,3	BT-016	2	3														2	2
<i>C. zae</i> de Weerd, 2000*	3	BT-129			4														
<b>O. Haplosclerida, Niphathiidae</b>																			
<i>Amphimedon compressa</i> D. & M., 1864	1-3	BT-043					1	2			2				2			3	2
<i>A. eriva</i> (de Laub., 1936)	1-3	BT-058					1	1	2		2				4				
<i>A. viridis</i> D. & M., 1864	3	BT-064									1								
<i>N. caycedoi</i> Zea & Van Soest 1986	3	BT-11	2															2	2
<i>Niphates erecta</i> D. & M., 1864	1-3	BT-07	4	3	3		1	2	2		2			1	2		1	3	2
<i>Aka</i> cf. <i>brevitubulata</i> (Pang, 1973)**	1																		
<i>A. coralliophagon</i> (Rützler, 1971)**	1-3	NS					3								3				
<b>O. Haplosclerida, Callyspongiidae</b>																			
<i>Callyspongia armigera</i> D. & M., 1864	2,3	BT-142																	
<i>C. fallax</i> (D. & M., 1864)	3	NS	3	4			3								2				4
<i>C. pallida</i> (Hechtel, 1965)	3	BT-079																	
<i>C. vaginalis</i> (D. & M., 1864)	1-3	NS					3								2			2	2
<b>O. Haplosclerida, Phloeodictyidae</b>																			
<i>Oceanapia bartschii</i> (De Laub., 1934)	2,3	BT-071																1	
<i>O. nodosa</i> (G. & W., 1919)	1,3	NS																4	4
<i>O. oleracea</i> (Schmidt, 1870)	3	BT-149																3	3
<i>O. peltata</i> (Schmidt, 1870)	3	BT-148																2	2
<i>Calyx podiatypa</i> (de Laub., 1934)**	2,3	BT-057					3									3			









TABLE 2. Continued.

Species	Rf	Sample #	Mangrove				Reef				Mangrove and reef						
			EP	SI	S2	AK	CK	SK	Ti	C	CK	PI	SP	PC	BB	S3	
<i>Plakortis halichondroides</i> (Wil., 1902)	2																
<i>P. angulospiculatus</i> (Carter, 1882)	2,3	BT-037				2								3			
<i>Plakinastrella onkodes</i> Ullizka, 1929**	3	BT-184															
<i>Oscarella</i> sp.	3	BT-034	4	1													
<b>Calcareo, O. Clathrinida, Clathrinidae</b>																	
<i>Clathrina primordialis</i> (Haeckel, 1872)	3	NS														4	
<b>O. Leucosoleniida, Grantiidae</b>																	
<i>Leucandra aspera</i> (Schmidt)	1																

\**Callyspongia armigera* was collected in Pta. Bastimentos

edge. Three main factors may have contributed to this large increase on species number. First, mangrove habitats were not included in earlier surveys (Guzmán and Guevara 1998, 1999; Guzmán 2003): forty-two percent (18 species) of the species added herein are restricted to this habitat. Second, the taxonomic expertise of the observer might have aided in the discrimination of species in this difficult group. Third, the general patchiness of sponge distribution in mangrove systems and the rarity of most species (Diaz et al. 2004) could also contribute to the increase of species numbers as new areas were surveyed. Another consideration is that more species are detected if large areas are surveyed by unrestricted swimming along suitable substrata, rather than being restricted to line transects placed along the mangrove fringe (Diaz et al. 2004).

It is quite possible that estimates of sponge diversity in Bocas del Toro region will double once there is data for deeper coral reefs (>20 ft), mangroves surrounding other islands (e.g., Cayo de Agua and Bastimentos), the bordering mainland section, and new habitats (cryptic reef areas, muddy bottoms, and coral rubble). Fair comparison of this region's diversity with that of others in the Caribbean realm must await the results of further exploration. With the collaboration of colleagues, four species, that seem new to science, are being studied to determine their generic and specific status. It is expected that more undescribed species will be found as the region is examined in more detail.

The most species-rich sponge genera in Bocas el Toro reef habitats are *Aplysina* (Aplysinidae, Verongida) and *Xestospongia* (Petrosiidae, Haplosclerida), with four and five species, respectively. In the mangrove, the most diverse genera are *Haliclona* (Chalinidae, Haplosclerida), and *Mycale* (Mycalidae, Poecilosclerida), with six and nine species, respectively. These genera are also very diverse in other Caribbean locations. In Bocas del Toro, the petrosiids, in particular *Xestospongia*, are highly diverse and abundant; it harbors typical Caribbean species (*X. muta*, *X. carbonaria*, and *X. subtriangularis*) as well as species described

from Colombia, and observed mostly in the West-Central Caribbean (*X. rosariensis*, and *X. proxima*).

Evaluation of species distribution at Bocas, although of qualitative nature, confirms certain trends reported previously. The patchiness of species distribution, where a large part of the species are seen only once or twice in a survey, was recorded by Rützler et al. (2001), Diaz et al. (2004), and Alcolado (unpublished data). The species spectrum of the most typical or common sponges from reefs, seagrass beds, or mangrove habitats conforms well with that of other Caribbean sites such as Cuba, Jamaica, Bahamas, Belize, Panama, Colombia, and Venezuela (Rützler 1969; Wiedenmayer 1977; Zea 1984; Farnsworth et al. 1996; Rützler et al. 2000; Wulff 2000; Diaz et al. 2004; Alcolado unpublished data).

The most common species on reefs habitats are *Aplysina fulva* (11 sites), *A. cauliformis* (8 sites), *Aiolochoxia crassa* (7 sites), *Ircinia campana* and *I. felix* (seven sites each), *X. carbonaria* (eight sites), *Iotrochota birotulata* (8 sites) and *Niphates erecta* (14 sites), which are common throughout the Caribbean and the Gulf of Mexico. Similarly, mangrove sponges such as *Haliclona tubifera* (6 sites), *Hyrtios proteus*, *Haliclona implexiformis*, and *Haliclona manglaris* (7 sites), *Tedania ignis*, and *Iotrochota birotulata* (8 sites), and *Clathria schoenus* (10 sites) are the most widely spread in Bocas del Toro, and in other Caribbean mangroves as well.

In this area one surprising pattern of species distribution is the high incidence of typical reef species, such as *Mycale laevis*, *Ircinia felix*, *Ircinia campana*, *Amphimedon compressa*, and *Niphates erecta*, on roots of the red mangrove (*Rhizophora mangle*). This situation might be a consequence of the proximity of reef and mangrove habitats. A similar pattern is found in mangrove ponds in the Pelican Cays, central Belize, where an important portion of sponges growing on the roots are typical reef species (Rützler et al. 2000; Wulff 2000). According to Wulff (2000) in Pelican Cays, the closeness of the reef and the presence of spongivorous reef species on the mangrove fringe contribute to this phenomenon. Overall, sponges in

the Bocas del Toro region are similar to those at other Caribbean sites, sharing the identity of the most common and widespread species, as well as the patchy distribution of most species at local scales.

*Acknowledgments.*—The author thanks the Smithsonian Institution-Marine Science Network for support to attend the first Bocas del Toro Biodiversity workshop held in August 2003. Dr. Rachel Collin (director) and Dr. Gabriel Jacóme (scientific coordinator), and support staff of the STR-Bocas del Toro Marine station are acknowledged for helping to accomplish this work. Dr. Klaus Rützler assisted with taxonomic advice, and Drs. Scott Nichols, Penny Barnes, and Pedro Alcolado provided unpublished data.

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